Complete Summary

GUIDELINE TITLE

ACR Appropriateness Criteria™ for suspected congenital heart disease in the adult.

BIBLIOGRAPHIC SOURCE(S)

American College of Radiology (ACR), Expert Panel on Cardiovascular Imaging. Suspected congenital heart disease in the adult. Reston (VA): American College of Radiology (ACR); 2002. 6 p. (ACR appropriateness criteria). [38 references]

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Congenital heart disease

GUIDELINE CATEGORY

Diagnosis

CLINICAL SPECIALTY

Cardiology
Family Practice
Internal Medicine
Radiology

INTENDED USERS

Health Plans
Hospitals

Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for adults with suspected congenital heart disease

TARGET POPULATION

Adults with suspected congenital heart disease

INTERVENTIONS AND PRACTICES CONSIDERED

1. Chest x-ray (posteroanterior [PA] and lateral)
2. Transthoracic echocardiograph with Doppler
3. Magnetic resonance imaging (MRI)
4. Cardiac catheterization with angiocardiography
5. Aortic magnetic resonance angiography (MRA)
6. Transesophageal echocardiograph
7. Computed tomography (CT)
    - Electron beam
    - Multidetector
8. Radionuclide
    - Shunt detection
    - Nuclear scintigraphy
9. Barium swallow

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of recent peer-reviewed medical journals, primarily using the National Library of Medicine's MEDLINE database. The developer identified and collected the major applicable articles.

NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Expert Consensus (Delphi Method)
Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the Appropriateness Criteria. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty (80) percent agreement is considered a consensus. If consensus cannot be reached by this method, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria and the Chair of the ACR Board of Chancellors.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria™

Clinical Condition: Suspected Congenital Heart Disease in the Adult

Radiologic Exam Procedure	Appropriateness Rating	Comments
Chest x-ray (PA and lateral)	9	
Transthoracic Echocardiograph with Doppler	8	
MRI	8	
Cardiac catheterization with angiocardiography	8	
Aortic MRA	6	
Transesophageal Echocardiograph	6	
CT		
Electron beam	6	
Multidetector	6	
Radionuclide		
Shunt detection	4	

Radiologic Exam Procedure	Appropriateness Rating	Comments
Nuclear scintigraphy	4	
Barium swallow	3	It may be useful in patients with suspected "ring" abnormalities.
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Abbreviations: PA, posteroanterior; MRI, magnetic resonance imaging; MRA, magnetic resonance angiography; CT, computed tomography

Chest Radiography/Fluoroscopy

The initial work-up of adults with suspected congenital heart disease (CHD) usually includes a posteroanterior (PA) and lateral chest radiograph. Occasionally the radiograph will be the first study to alert the radiologist and the clinician to the possibility of a congenital cardiac defect or great vessel anomaly. This simple and inexpensive examination remains a first-line test for patients with suspected CHD.

The chest radiograph is unique in demonstrating the pattern of pulmonary vascularity. It provides an assessment of cardiac size and configuration and identifies the position of the aortic arch. The situs of the abdomen and thorax can usually be determined. Thoracic cage anomalies associated with CHD and postoperative changes may also be detected. Barium opacification of the esophagus may clarify arch abnormalities. The chest radiograph continues to be an invaluable tool for following the patient with surgically treated CHD.

In adults with suspected aortic stenosis from a congenital bicuspid aortic valve, fluoroscopy is no longer used to confirm the presence of calcification in the valve. It may be used to identify calcifications in the pericardium and in surgically placed prostheses and conduits. Often, congenital bicuspid valves are so densely calcified that they may be seen on plain films--especially on the lateral projection. If necessary, spiral computed tomography (CT) is much more effective.

Echocardiography

Transthoracic echocardiography (TTE) remains a first-line imaging examination in adults with suspected CHD. This test has long been established as a clinically useful diagnostic modality for CHD in children, often eliminating the need for cardiac catheterization in uncomplicated lesions. Although adults present certain technical problems related to the need for lower frequency transducers, limited acoustical windows, and postoperative changes, this examination provides a unique, two-dimensional, real-time evaluation of the anatomic and hemodynamic relationships of intracardiac lesions.

Transthoracic echocardiography is widely available, reproducible, safe, and painless. It remains a valuable tool in the investigation of CHD.

The color flow Doppler feature of TTE is particularly suited for evaluating flow across atrial and ventricular septal defects (VSDs) as well as atrioventricular valve regurgitation. In postoperative patients, VSD patch defects can readily be visualized. Assessment of the valves (sclerosis, fusion, estimation of valve gradients) and determination of right ventricular systolic pressure can usually be achieved.

Conventional TTE, however, has difficulty in consistently providing high-quality clinically useful information in some adult patients with intracardiac defects. Imaging of the great vessel with TTE is difficult even in children and is even more problematic in adults who have poorer acoustical windows. In these situations, transesophageal echocardiography (TEE) and magnetic resonance imaging (MRI) have roles to play.

Current two-dimensional TTE is limited by a field of view of 90Â° and the need for the examiner to assimilate tomographic slices into a three- or four-dimensional diagnosis. The recent development of a rotational acquisition format with dynamic volume rendering has allowed presentation of TTE in a three-dimensional display. Additional information about the mitral valve, aortoseptal continuity, and the intraatrial septum appears to be additive to information obtained from standard two-dimensional images.

Transesophageal echocardiography has clear advantages over TTE in adolescents and adults with CHD. New information obtained with TEE as compared to TTE includes identification of the atrial appendages and atrial septum, delineation of systemic and pulmonary venous connections, improved morphologic assessment of the atrioventricular junction and valves, improved definition of subaortic obstruction, improved definition of the ascending aorta and coronary arteries, and better evaluation of atrial baffle function and Fontan anatomy. Limitations of TEE include limited planes of view of the apical and anterior septum and blind areas created by masking of flow by implanted prosthetic material. Areas that may be difficult to visualize are the right ventricular outflow tract, the pulmonary valve, the distal right pulmonary artery, and the proximal left pulmonary artery. With the addition of the vertical axis in the newer probes, these problem areas as well as the pulmonary veins are better seen.

The standard TEE requires administration of a local anesthetic to the pharynx and intravenous midazolam in small doses. In large studies, it has been shown that the examination may be unsuccessful in up to 5% of patients due to their inability to tolerate the probe after intubation. Another 4%-5% of patients have the examination while under general anesthesia as part of invasive or surgical procedures. Although the risk of bacterial endocarditis from TEE is small, and prophylactic antibiotics are not routinely administered, endocarditis has been attributed to the procedure.

Transesophageal echocardiography is clearly operator-dependent. In an area as complex as congenital heart disease, the examiner must be trained to interpret the findings in real time, so that important information is not missed.

With improvements and refinements in echocardiographic technology, most adults attending an outpatient clinic undergo TTE and, when necessary, complementary TEE and MRI. Two-dimensional imaging is more challenging in this patient population because of large body size and often multiple previous surgical scars. The use of TEE intraoperatively is also increasing, and it has been shown that it has a major impact on cardiac surgical procedures in 6%-9% of cases (i.e., that it is desirable or necessary for the patient to be put back onto cardiopulmonary bypass for revision of the cardiac procedure). Physicians interpreting these echocardiograms need to be experienced and have expertise in all aspects of CHD.

A high rate of diagnostic error in pediatric echocardiograms performed in community-based adult laboratories has been reported. One study found that patients of varying ages, from 1 day to 18 years, had either interpretive or technical errors that were of major or moderate importance in 53% of cases. There is reason to believe that in older patients errors occur even more frequently because image acquisition is more challenging. Clearly, both expertise and technology are necessary to provide the best care.

Radionuclide Imaging

Although quantitation of right-to-left shunts is feasible using technetium (Tc) 99m first-pass techniques, it is seldom used today. There are, however, a few selected uses for radionuclide imaging in the evaluation of adults with CHD. Left ventricular dysfunction is known to complicate certain long-standing congenital heart defects associated with right and left heart volume overload. Left ventricular radionuclide scintigraphy with ejection fraction calculation is a useful noninvasive technique for evaluating these patients. In some adult patients with abnormal pulmonary blood flow patterns related to conditions such as pulmonary artery agenesis, ventilation-perfusion lung scanning may assist in the diagnosis. A rare congenital anomaly, origin of the left coronary artery from the pulmonary artery, may result in left ventricular ischemia. This may be detected with thallium 201 SPECT (single photon emission computed tomography) scanning.

Computed Tomography

Standard and spiral computed tomography (CT) are capable of contributing valuable information about congenital abnormalities of the thoracic aorta including the identification of vascular rings and postoperative complications such as pseudoaneurysm. The need for intravenous contrast material and exposure to radiation, however, has limited their use in the pediatric population with congenital heart disease (CHD).

Ultrafast or electron beam CT (EBCT) has reduced scan time and with multislice capability, can evaluate the entire heart and great vessel region in a three-dimensional matrix of CT information. Essentially all types of congenital cardiac malformations have been accurately described with this technique. Retrospective or prospective electrocardiogram (EKG) gating with multidetector CT presents the opportunity to gather essentially the same information as obtained with EBCT, with higher spatial, but lower temporal resolution. Radiation dose is greater with retrospective gating. Iodinated contrast enhancement not only depicts cardiac structures, it also can be used to provide information about blood flow using

indicator-dilution techniques. Ultrafast CT has been used to calculate cardiac output, shunt flow, pulmonary-to-systemic flow ratios, ventricular volumes, ejection fraction, regurgitant volumes, and myocardial mass. Its limited availability and cost, however, have restricted its use.

Magnetic Resonance Imaging

"Black-blood" technique (e.g., spin-echo MRI) is useful for delineating cardiac anatomy. "White-blood" techniques (e.g., gradient-echo studies) can demonstrate flow abnormalities related to lesions such as a mitral insufficiency, tricuspid insufficiency, ventricular septal defect (VSD), and so forth. Echoplanar and k-segmentation techniques have shortened the acquisition time markedly allowing many studies to be performed during breath holding. This has also ameliorated the distress of claustrophobic patients. The use of Navigator respiratory gating methods has improved image quality, especially of the coronaries.

Phase contrast techniques demonstrate directional blood flow and allow quantification of blood flow and pressure gradients across valves. Defining the plane in which the jet velocity is maximal can be difficult with MRI. However, with new improvements in software this is becoming easier.

Magnetic resonance imaging has been used for the diagnosis of essentially all congenital heart and great vessel abnormalities. Conventional spin-echo MRI has been shown to have specificity of 90% associated with having high sensitivity in evaluating: great vessel relationships (100%), thoracic aortic abnormalities (94%), atrial septal defects (ASDs) (91%), VSDs (100%), visceroatrial situs (100%), and the cardiac loop (100%). Pulmonary and systemic venous anomalies and right ventricular outflow obstructions are also detected with high sensitivity. Vascular rings can be accurately diagnosed without the need for angiography. Lesions of the aortic, mitral and tricuspid valves have a much lower detection rate, in the range of 52%-76% sensitivity.

Gradient-echo imaging acquisition viewed in a cine format facilitates physiologic measurements including stroke volume, ejection fraction, and wall motion analysis of both ventricles. Blood flow, valve gradients, shunt flow, regurgitant flow, and pulmonary flow can all be measured using velocity-encoded cine techniques. Oxygen saturation determinations within the cardiac chambers appear to be feasible using modified MRI sequences.

Magnetic resonance imaging seems to be ideally suited to evaluating adults with suspected or known CHD. Although claustrophobia in the gantry may require sedation in a few patients, the study is noninvasive, and is not affected by body habitus. It provides high spatial resolution even in the most complex circumstances without the limitation of imaging "windows." The resultant images obtained in essentially any plane provide a three-dimensional presentation of cardiac anatomy. Magnetic resonance imaging is useful as well in the evaluation of the postoperative patient with CHD, whether it is a palliative procedure, a surgically created conduit, or reconstructed great vessels.

There is only one definite contraindication to MRI: Patients with standard cardiac pacemakers are currently excluded from the procedure. Even with the use of MRI contrast agents, contrast reactions are rarely an issue. Detection of calcification is

a problem for MRI, so adults with homografts or bioprosthetic valved conduits in whom the detection of calcification implies deterioration may not be optimally imaged. Motion and respiratory artifacts may pose a problem on some examinations. Real-time MRI has recently been introduced and can facilitate evaluation in patients with dysrhythmias or limited breath hold capacity. Current implementations are of lower resolution than standard techniques. Current cine studies represent a summation of acquisitions gated from the electrocardiogram (ECG). Any factor that affects ECG gating therefore may degrade the images, atrial fibrillation being the most common cause. Sternal wires, vascular clips, biosynthetic valve rings, and mechanical valves can all interfere with the quality of the images and thereby limit the clinical value of the examination in some patients.

In terms of specific defects, MRI is probably not as accurate as color flow Doppler in visualizing small ventricular and atrial defects. Cardiac MR studies require supervision and monitoring of the procedure by a physician who understands the clinical question and can acquire an appropriate and optimal imaging study. This is essential for consistency and reliable data. Thickening of the atrioventricular valves and the diagnosis of bicuspid or fused aortic valves are perhaps better achieved with TEE. All other cardiac lesions are at least as well or superiorly evaluated by MRI, provided the radiologist and technologist understand the methodology and address the specific clinical question.

Future developments in MRI may optimize the acquisition of functional data and provide real-time visualization of cardiac structures, much as echocardiography does now.

Transthoracic and Transesophageal Echocardiography versus Magnetic Resonance Imaging

Few prospective studies are available to compare transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) with magnetic resonance imaging (MRI). Studies limited to specific congenital lesions (coarctation of the aorta, subpulmonary and pulmonary artery anomalies) indicate that MRI gives a more reliable assessment of severity and is technically more successful than TTE. Studies comparing TTE with MRI in the evaluation of patients who have had surgical correction or palliation of CHD indicate that MRI information is additive to that from TTE. In patients who have had palliative and corrective surgery for cyanotic heart disease, MRI and TEE are equivalent for demonstrating abnormalities of the right ventricular outflow tract, main pulmonary artery and systemic-to-pulmonary shunts. Magnetic resonance imaging is superior in demonstrating abnormalities of the right and left pulmonary arteries. When TTE and MRI are compared in a variety of congenital heart lesions, MRI is comparable to echo in evaluating isolated intracardiac defects but more useful in the diagnosis of complex congenital lesions.

When TEE and MRI have been evaluated prospectively in adults with CHD, TEE is shown to be superior in evaluating intracardiac anatomy; MRI is superior for extracardiac anatomy and is slightly better than TEE for hemodynamic and functional evaluation. Taken individually, the two modalities provided similar overall diagnostic information, but when used in combination, they provide important complementary information in all diagnostic categories.

Cardiac Catheterization and Angiocardiography

Cardiac catheterization has been the diagnostic "Gold standard" for congenital heart disease (CHD) over the past 50 years. For the past 20 years, it has been increasingly supplemented by noninvasive diagnostic modalities; initially, cardiac ultrasound and more recently, computed tomography (CT) scanning and MRI. Advances in these technologies have been logarithmic, and it is likely that in the coming decade, both morphologic and functional assessments of this patient population will be increasingly accomplished noninvasively.

Today, diagnostic catheterization is largely reserved for resolving specific issues concerning operative interventions including 1) the preoperative evaluation of coronary arteries; 2) the assessment of pulmonary vascular disease and its response to vasoactive agents for planned, traditional surgical intervention, and/or heart or heart/lung transplantation; and 3) as an adjunct to the noninvasive assessment of the morphologic and functional characteristics of many complex congenital lesions (e.g., delineation of arterial and venous anatomy, patients with heterotaxy, Fontan candidates, and patients who have had previous palliation in the form of a shunt). Experienced and trained operators who maintain an adequate minimal volume annually should perform such procedures.

Evaluation for possible interventional catheterization has become an increasingly common indication for diagnostic catheterization. For some lesions, notably valvular pulmonary stenosis, branch pulmonary stenosis, residual or recurrent aortic coarctation, and arteriovenous fistulae, catheter intervention is widely considered to be the treatment of choice. Coil or device occlusion of the patent ductus produces results comparable to those of surgical closure, and device closure of secundum atrial septal defects is often used, although the success rate varies with operator expertise and the specific device used. It is likely that technical problems related to these devices will ultimately be overcome. Dilation of stenotic palliative shunts can obviate the need for re-operation, and transcatheter occlusion of shunts before repair of intracardiac lesions may simplify the surgical procedure. Along with the growth of interventional catheterization, there has been a renewed interest in small-incision cardiac surgery, and there will likely be continued advocacy for both management alternatives. Finally, a national and global perspective must be kept in mind, relative to limited resources in developing regions where interventional catheterization may provide partial or definitive treatment for many patients with CHD who do not have access to cardiac surgery.

For many years, the purpose of cardiac catheterization and angiocardiography for CHD was to acquire pressure, oximetric, and morphologic data. Pressures defined gradients across stenosis and between cardiac chambers connected by defects as well as the severity of pulmonary hypertension. Oxygen saturations helped to define the volume of shunts. Morphologic data of simple and complex anomalies were achieved by cine angiograms using angulated views, contrast material, and radiation. For the most part, these studies were accomplished safely but with some morbidity (contrast reactions, renal failure, hematomas, arterial and venous injuries, radiation exposure, etc.) and a small but definite mortality.

Although cardiac catheterization continues to be performed and is currently still considered by many to be the "Gold standard" in the evaluation of CHD,

noninvasive methods increasingly limit the need for catheterization unless intervention is considered. Many simple congenital cardiac defects are now sent to surgery without catheterization. In the future, cardiac catheterization and angiocardiography may very well be reserved as a complement to these noninvasive techniques in the evaluation of adults with suspected CHD. However, until these less invasive studies provide an accurate depiction of the coronary arteries, the catheterization laboratory will continue to be involved in the assessment of this unique group of adult patients.

CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Appropriate selection of initial radiologic exam procedures for suspected congenital heart disease

POTENTIAL HARMS

- There is a small risk of bacterial endocarditis from transesophageal echocardiography (TEE).
- Sternal wires, vascular clips, biosynthetic valve rings, and mechanical valves can all interfere with the quality of magnetic resonance images and thereby limit their clinical value.

Subgroups Most Likely to be Harmed:

- Detection of calcification is a problem for magnetic resonance imaging (MRI), so adults with homografts or bioprosthetic valved conduits in whom the detection of calcification implies deterioration may not be optimally imaged.
- Patients with standard cardiac pacemakers are currently excluded from magnetic resonance imaging.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging

examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Living with Illness

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

American College of Radiology (ACR), Expert Panel on Cardiovascular Imaging. Suspected congenital heart disease in the adult. Reston (VA): American College of Radiology (ACR); 2002. 6 p. (ACR appropriateness criteria). [38 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1998 (revised 2002)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria™.

GUIDELINE COMMITTEE

ACR Appropriateness Criteria™ Committee, Expert Panel on Cardiovascular Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: Michael J. Kelley, MD; Martin J. Lipton, MD; Michael A. Bettmann, MD; Lawrence M. Boxt, MD; Antoinette S. Gomes, MD; Julius Grollman, MD; Heriberto Pagan-Marin, MD; Joseph F. Polak, MD, MPH; Neil M. Rofsky, MD; David Sacks, MD; William Stanford, MD; Jack A. Ziffer, MD, PhD; Gregory L. Moneta, MD; Michael Jaff, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline. It updates a previously published version: Suspected congenital heart disease in the adult. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):67-72.

The ACR Appropriateness Criteria™ are reviewed after five years, if not sooner, depending upon introduction of new and highly significant scientific evidence. The anticipated next review date for this topic is 2007.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

Print copies: Available from American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on February 20, 2001. The information was verified by the guideline developer on March 14, 2001. This summary was updated by ECRI on March 31, 2003. The updated information was verified by the guideline developer on April 21, 2003.

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